DGP-WG/22-IP/11 25/11/22



DANGEROUS GOODS PANEL (DGP) WORKING GROUP MEETING (DGP-WG/22)

Montréal, 21 to 25 November 2022

Agenda Item 4: Managing safety risks posed by the carriage of lithium batteries by air (Ref: Job Card DGP.003.04)

STATUS OF SAE G-27 LITHIUM BATTERY PACKAGING PERFORMANCE COMMITTEE

(Presented by Doug Ferguson)

SUMMARY

Attached is the presentation delivered to DGP-WG/22 on status of SAE G-27 lithium battery packaging performance committee.

(15 pages) DGPWG.22.IP.011.4.en.docx SAE INTERNATIONAL

STATUS OF SAE G-27 LITHIUM BATTERY PACKAGING PERFORMANCE COMMITTEE

Presented at Tenth Triennial Aircraft Cabin and Fire Safety Conference October 19, 2022

Doug Ferguson, Co-Chair G-27 Committee Claude Chanson, Co-Chair G-27 Committee Maureen Lemankiewicz, SAE Specialist G27 Committee



Standards Development Process

SAE G-27 Committee formed in March, 2016 at ICAO ANC request to create a performance-based package standard (AS6413) for the safe transport of lithium batteries as cargo by air.

Co-chaired by Doug Ferguson (Boeing) and Claude Chanson (Recharge)

~ 200 individuals on G-27 Committee

- Includes international organizations, airframe manufacturers, regulators, cell manufacturers, battery manufacturers, battery users, operators, package manufacturers, test facilities
- ~ 40 Voting members,
- ~ 75 individuals consistently, actively engaged
 - Monthly Webex teleconference calls
 - Average of 3 in-person multi-day meetings per year (multi-day meetings virtual in 2020 and 2021, and Hybrid face to face working groups combined with virtual committee meetings in 2022)
 - Next in-person meeting will be in San Diego in November, 2022

Documents in process:

AS6413: Performance based package standard for lithium ion cylindrical cells as cargo on aircraft

AS6413/1: Performance based package standard for lithium batteries as cargo on aircraft – Package Testing with External Thermal Challenge

AS6413/2: Performance based package standard for lithium batteries as cargo on aircraft – Package Testing with Direct External Flame

AIR6840: Performance based package standard for Lithium batteries as cargo on aircraft – Background Information and Rationales

SAE G27 Document Progress Timeline (as of October 2022)

AS6413

- This standard provides a test method to demonstrate and document the control of the potential hazards from Lithium metal batteries (UN 3090) and Lithium ion batteries (UN 3480) when transported as cargo on aircraft.
- It addresses the need to control the hazards which might arise from a failure of an individual cell by containing the hazards within the package.
- Controlling the consequences of a failure within the package is intended to prevent uncontrolled fire and pressure pulses that may compromise current fire suppression systems within the cargo compartment.
- The intent of this test is to severely abuse a single cell such that it is most likely to enter thermal runaway with the presumption that a single cell may enter thermal runaway during transport.

AS6413

Intention is to address the safety of the cell/battery and packaging material (box, etc) together. Allow for less protection from the package if the cell is inherently safer.

- 1. Initiate a thermal runaway in a cell within the package by heating at ~ 10 °C per minute.
- 2. Remove heater power when cell has entered thermal runaway.
- 3. If no confirmation of cell thermal runaway after cell reaches 200 °C, maintain at that temperature for one hour and then remove heater power.
- 4. Monitor pass/fail criteria for 5 hours after removing power.

AS6413 Pass/Fail Criteria

• Verification of "non-hazardous flame" and "non hazardous particle" achieved visually or with witness panels

- Visually: no flame or fragments
- Witness panel: cheese cloth placed less than 25 mm away from package does not ignite

- Surface temperature of package shall not be sufficient to ignite adjacent materials.

- Temperature of thermocouple placed on package surface adjacent to the initiation cell shall not increase by more than 150 C for more than 3 minutes during the remaining 5 hours after the heater for the initiation cell is turned off.
- Average increase in temperature of each thermocouple on each face of package shall not be greater than 100 C during the remaining 5 hours after the heater for the initiation cell is turned off.

- Non-hazardous quantity of flammable vapor released outside package

• No ignition of vapor collected within test chamber

AS6413 Basic (baseline) test method

[video courtesy of FAA Technical Center]

Baseline test method has been validated with cylindrical lithium ion cells.

Many additional "variations" or alternatives still require validation, including cells in batteries.

- Pouch and prismatic types (one lab's data provided in July)
- Reduced cell quantity in package (one lab's data provided in July)
- Lithium metal
- Benign @SOC
- Oversize package
- Generic package (Universal Packaging)

AS6413/1

Elevated Temperature Test (Oven Test)

• 3 hours at 205 C

Material Test:

- Package made from materials to be in final product
- Simulated 18650 cell with thermocouple in center
- Thermocouple does not exceed [100 C]

Or

Package with Cells test:

- No thermal runaway
- Any venting does not result in hazardous quantity of flammable gas (not defined)

AS6413/2

Direct Flame Test

FAA Oil burner horizontal test 5 minutes

Material Test:

- Test articles made from materials and interfaces to be in final product
- Simulated 18650 cell with thermocouple in center
- No burn-through
- Thermocouple does not exceed [100C]

Or

Package with Cells test:

- No burn-through
- No thermal runaway

• Any venting does not result in hazardous quantity of flammable gas (not defined) SAE INTERNATIONAL

AS 6413 Draft Content

NEXT STEPS

- Finish validation testing of "baseline" test method to include all lithium ion cells and reduced cell configuration to have a "narrow scope" standard to be balloted before end of 2022.
 - Facilitate discussions outside the G27 committee between operators, shippers, test labs, and authorities
 - What requirements are expected to be contained within standard?
 - How is standard expected to be incorporated into regulations?
 - Use the released standard to conduct a true "round-robin" review of the ability of the test standard to provide consistent results from multiple labs unfamiliar with the standard
- Publish AIR with appropriate intended use, rationales for various parameters
- Validate external fire test methods and publish those slash sheets
- Continue to validate test methods for lithium metal, Benign @SOC, Oversize, and Generic for expanded scope standard in the near future.

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QUESTIONS?

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